

Appl. No. 10/453,411  
Amdt. Dated June 15, 2005  
Response to Office Action Dated March 22, 2004

### **AMENDMENTS TO THE CLAIMS**

This listing of claims will replace all prior versions, and listings, of claims in the application.

#### **Listing of Claims**

1. (Currently Amended) A method comprising:  
operating a logging tool in a borehole, the logging tool having a transmitting antenna;  
sending a control signal to a relay across a signal line that couples an antenna signal to the transmitting antenna, thereby selectively tuning the transmitting antenna;  
transmitting from the transmitting antenna an electromagnetic wave having a first frequency;  
transmitting from the transmitting antenna an electromagnetic wave having a second frequency; and  
transmitting from the transmitting antenna an electromagnetic wave having a third frequency.
2. (Cancelled)
3. (Currently Amended) The method as defined in claim 2-1 wherein selectively tuning further comprises controlling an amount of capacitance coupled to the transmitting antenna.
- 4.-5. (Cancelled)
6. (Currently Amended) The method as defined in claim 2-1 wherein selectively tuning further comprises controlling inductance of the winding antenna.
- 7.-8. (Cancelled)
9. (Previously Presented) The method as defined in claim 1 wherein operating further comprises operating a logging while drilling tool in the borehole.

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10. (Currently Amended) A logging tool comprising:  
a tool body configured for use in a borehole;  
a receiving antenna disposed on the tool body; and  
a transmitting antenna disposed on the tool body at a spaced apart location from the receiving antenna; and  
an antenna tuning circuit comprising a relay having a coil, the coil coupled to a signal line that carries signals to the transmitting antenna, wherein the antenna tuning circuit is selectively tunable to obtain a plurality of resonant frequencies  
~~wherein the transmitting antenna is selectively operable at three or more resonant frequencies for transmitting electromagnetic radiation.~~

11. (Currently Amended) The logging tool as defined in claim 10 further comprising an antenna tuning circuit coupled to the transmitting antenna, wherein the antenna tuning circuit operable to selectively couple capacitance to the transmitting antenna to obtain the three or more plurality of resonant frequencies.

12. (Currently Amended) A logging tool comprising:  
a tool body configured for use in a borehole;  
a receiving antenna disposed on the tool body;  
a transmitting antenna disposed on the tool body at a spaced apart location from the receiving antenna, wherein the transmitting antenna is selectively operable at three or more resonant frequencies for transmitting electromagnetic radiation;  
an antenna tuning circuit coupled to the transmitting antenna, the antenna tuning circuit operable to selectively couple capacitance to the transmitting antenna to obtain the three or more resonant frequencies, the antenna tuning circuit further comprising:

~~The logging tool as defined in claim 11 wherein the antenna tuning circuit further comprises:~~  
~~a relay having a coil, the coil coupled to a signal line that carries signals to the transmitting antenna;~~

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    said relay having a set of contacts selectively coupled by activation of the coil; and

    wherein in a first contact position a capacitance is coupled to the transmitting antenna, and

    wherein in second contact position the capacitance is not coupled to the transmitting antenna.

13. (Original) The logging tool as defined in claim 12 wherein the relay couples within a junction box proximate to the transmitting antenna.

14. (Currently Amended) The logging tool as defined in claim 10 ~~further comprising an antenna tuning circuit coupled to the transmitting antenna, wherein the antenna tuning circuit operable to selectively couples~~ windings of the transmitting antenna to obtain the three of more resonant frequencies.

15. (Currently Amended) A logging tool comprising:  
a tool body configured for use in a borehole;  
a receiving antenna disposed on the tool body; and  
a transmitting antenna disposed on the tool body at a spaced apart location from the receiving antenna, wherein the transmitting antenna is selectively operable at three or more resonant frequencies for transmitting electromagnetic radiation;  
an antenna tuning circuit coupled to the transmitting antenna, the antenna tuning circuit operable to selectively couple windings of the transmitting antenna to obtain the three of more resonant frequencies, the antenna tuning circuit further comprising:  
The logging tool as defined in claim 14 wherein the antenna tuning circuit further comprises:

    a relay having a coil, the coil coupled to a signal line that carries signals to the transmitting antenna;

    said relay having a set of contacts selectively coupled by activation of the coil; and

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wherein in a first contact position a first set of windings of the transmitting antenna is coupled in parallel with a second set of windings of the transmitting antenna, and

wherein in second contact position the first set of windings of the transmitting antenna is coupled in series with the second set of windings of the transmitting antenna.

16. (Original) The logging tool as defined in claim 15 wherein the relay couples within a junction box proximate to the transmitting antenna.
17. (Original) The logging tool as defined in claim 10 further comprising:
  - a plurality of receiving antennas disposed in the tool body;
  - a plurality of transmitting antennas disposed on the tool body; and
  - wherein at least one of the plurality of transmitting antennas is selectively operable at three or more resonant frequencies.
18. (Original) The logging tool as defined in claim 17 further comprising:
  - three receiving antennas disposed on a medial portion of the tool body;
  - three transmitting antennas disposed on a first end of the tool body; and
  - three transmitting antennas disposed on a second end of the tool body.
19. (Original) The logging tool as defined in claim 18 wherein the tool body further comprises a tool body adapted for use within a drillstring.
20. (Currently Amended) A bottom hole assembly comprising:
  - a drill bit;
  - a logging tool coupled to the drill bit, the logging tool comprising:
    - a tool body;
    - a plurality of receiving antennas disposed on the tool body; and

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a plurality of transmitting antennas disposed on the tool body at a spaced apart location from each other and the receiving antennas;  
an antenna tuning circuit comprising a relay having a coil, the coil coupled to a signal line that carries signals to a first transmitting antenna, wherein the antenna tuning circuit is selectively tunable to obtain a plurality of resonant frequencies  
~~wherein each transmitting antenna is selectively operable at greater than two resonant frequencies for transmitting electromagnetic radiation.~~

21. (Currently Amended) The logging tool as defined in claim 20 further comprising a plurality of antenna tuning circuits coupled one each to the plurality of transmitting antennas, each antenna tuning circuit each selectively couples capacitance to its respective transmitting antenna to achieve ~~the greater than two~~ a plurality of resonant frequencies.

22. (Currently Amended) A bottom hole assembly comprising:  
a drill bit;  
a logging tool coupled to the drill bit, the logging tool comprising:  
a tool body;  
a plurality of receiving antennas disposed on the tool body; and  
a plurality of transmitting antennas disposed on the tool body at a spaced apart location from each other and the receiving antennas;  
wherein each transmitting antenna is selectively operable at greater than two resonant frequencies for transmitting electromagnetic radiation;  
a plurality of antenna tuning circuits coupled one each to the plurality of transmitting antennas, each antenna tuning circuit each selectively couples capacitance to its respective transmitting antenna to achieve the greater than two resonant frequencies. The logging tool as defined in claim 21 wherein each antenna tuning circuit further comprises:  
a relay having a coil, the coil coupled to a signal line that carries signals to a transmitting antenna;

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said relay having a set of contacts selectively coupled by activation of the coil; and

wherein in a first contact position a capacitance is coupled to the transmitting antenna, and

wherein in second contact position the capacitance is not coupled to the transmitting antenna.

23. (Original) The logging tool as defined in claim 22 wherein the relay couples within a junction box proximate to its respective transmitting antenna.

24. (Currently Amended) The logging tool as defined in claim 20 further comprising a plurality of antenna tuning circuits coupled one each to the transmitting antennas, each antenna tuning circuit operable to selectively couple windings of a transmitting antenna to achieve the greater than two plurality of resonant frequencies.

25. (Currently Amended) A bottom hole assembly comprising:  
a drill bit;  
a logging tool coupled to the drill bit, the logging tool comprising:  
a tool body;  
a plurality of receiving antennas disposed on the tool body; and  
a plurality of transmitting antennas disposed on the tool body at a spaced apart  
location from each other and the receiving antennas, wherein each  
transmitting antenna is selectively operable at greater than two resonant  
frequencies for transmitting electromagnetic radiation;  
a plurality of antenna tuning circuits coupled one each to the transmitting antennas, each  
antenna tuning circuit operable to selectively couple windings of a transmitting  
antenna to achieve the greater than two resonant frequencies, The logging tool as  
defined in claim 24 wherein each antenna tuning circuit further comprises:  
a relay having a coil, the coil coupled to a signal line that carries signals to  
a transmitting antenna;

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    said relay having a set of contacts selectively coupled by activation of the coil; and

    wherein in a first contact position a first set of windings of the transmitting antenna is coupled in parallel with a second set of windings of the transmitting antenna, and

    wherein in second contact position the first set of windings of the transmitting antenna is coupled in series with the second set of windings of the transmitting antenna.

26. (Original) The logging tool as defined in claim 25 wherein the relay couples within a junction box proximate to its respective transmitting antenna.

27.-28. (Cancelled)

29. (Currently Amended) A method comprising:

    operating a logging tool in a borehole, the logging tool having a first and second antennas;

    transmitting an electromagnetic wave ~~having a first frequency~~ from the first antenna; and  
    tuning the second antenna to resonate at a ~~second other than the frequency of the~~  
~~electromagnetic wave during transmitting transmitted by the first antenna, the~~  
~~second frequency different than the first frequency.~~

30. (Previously Amended) The method as defined in claim 29 wherein tuning the second antenna further comprises controlling an amount of capacitance coupled to the second antenna.

31. (Previously Amended) The method as defined in claim 29 wherein tuning the second antenna further comprises controlling inductance of the second transmitting antenna.

32.-41. (Cancelled)